NUMERICAL ALGORITHMS FOR MAGNETOHYDRODYNAMICS OF FREE SURFACE MULTIFLUID SYSTEMS

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We have developed numerical algorithms and computational software for the study of magnetohydrodynamic (MHD) free surface flows in multifluid systems with strong discontinuites in physical properties. The system of MHD equations for free surface flows is an example of strongly coupled hyperbolic and parabolic/elliptic systems in moving and geometrically complex domains. The hyperbolic system is solved using the front tracking technique. Parallel algorithms for solving elliptic and parabolic equations in three dimensions with strong, geometrically complex discontinuites in the coefficient matrix defing the Laplacian operator were implemented using Raviart-Thomas and Whitney finite element discretizations on moving grids dynamically conforming to fluid interfaces. The method was implemented as an MHD extension of the FronTier code. The code is applied for modeling the behavior of a liquid mercury jet interacting with high energy proton pulses in a strong magnetic field (the proposed target for the Muon Collider), lithium jets and films in magnetic confinement fusion devices, and some fundamental MHD problems.